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भारतीय मानक

पर्यावरण अवस्थाओं का वर्गीकरण

भाग 3 पर्यावरण पेरामीटर और उनकी कठोरताओं के समूहों का वर्गीकरण

अनुभाग 5 भूमि वाहन संस्थापन

Indian Standard

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS

PART 3 CLASSIFICATION OF GROUPS OF ENVIRONMENTAL PARAMETERS AND THEIR SEVERITIES

Section 5 Ground Vehicle Installations

(First Reprint MAY 2004)

UDC 621·38·038 : 620·193 : 629·113

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NEW DELHI 110002

***September* 1993** **Price Group 10**

Environmental Testing Procedures Sectional Committee, LT 02

NATIONAL FOREWORD

This Indian Standard, which is identical with IEC Pub 721-3-5 (1985) 'Classification of environmental conditions — Part 3 : Classification of group of environmental parameters and their severities — Ground vehicle installations', issued by the International Electrotechnical Commission, was adopted by the Bureau of Indian Standards on the recommendation of the Environmental Testing Procedures Sectional Committee (LT 02) and approval of the Electronics and Telecommunication Division Council.

The text of the IEC standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

> Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard'.

The concerned technical committee has reviewed the provisions of IEC 721-3-0 (1984), IEC 721-3-1 (1987) IEC 721-3-2(1985), referred in this standard and has decided that they are acceptable for use in conjunction with this standard.

Part 1 of this Indian Standard deals with classification of environmental parameters and their severities. The subsequent parts are intended to deal with the following:

a) Environmental conditions appearing in nature.
b) Classification of groups of environmental parameters and their severities.

Amendment No. 1 issued to IEC Pub 721-3-5 (1985) is given at the end.

Only the English language text in the International Standard has been retained while adopting it in this Indian Standard.

IEC
721-3-5

Amendment 1

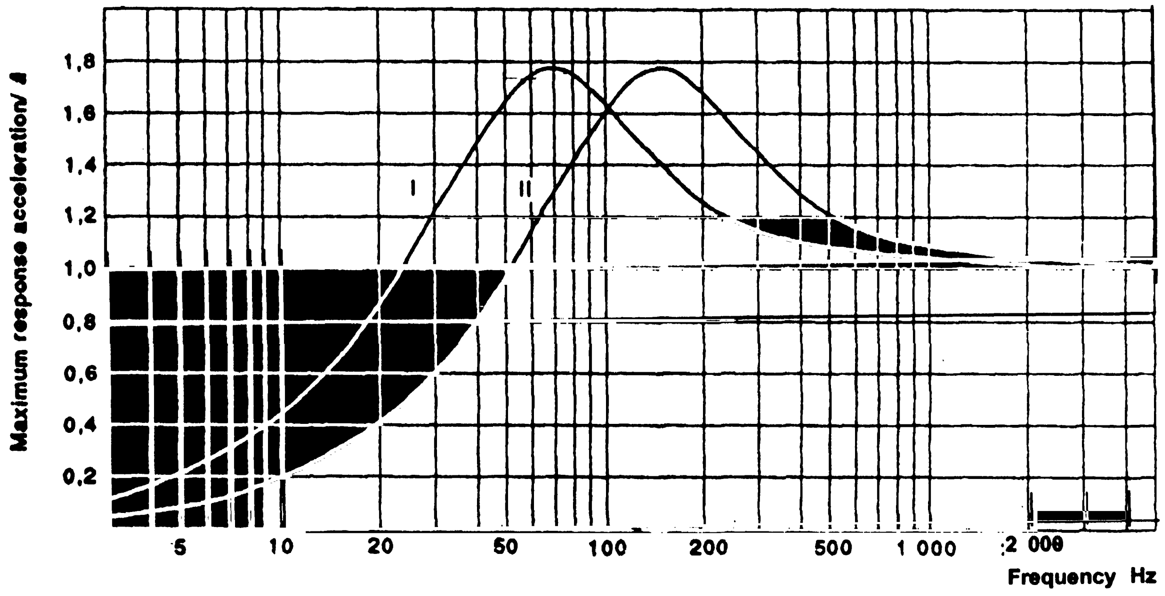
Page 7

TABLE VI: *Classification of mechanical conditions*

In column 5M3, item d), second line, change if *to* of.

Page a

Replace figure 1 by the following:



Example of durations for half-sine pulse:

Spectrum type I: duration 11 ms
Spectrum type II: duration 6 ms

Figure 1 - Model shock response spectra (first order **maximax** shock response spectra). For explanation **see** note 6 relating to table I of IEC 721-1 (1990)

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Indian Standard
CLASSIFICATION OF ENVIRONMENTAL CONDITIONS

PART 3 CLASSIFICATION OF GROUPS OF ENVIRONMENTAL PARAMETERS AND THEIR SEVERITIES

Section 5 Ground Vehicle Installations

1. Scope

This standard classifies the environmental conditions to which a product not forming part of the vehicle is subjected when installed in a ground vehicle. Such products are for example radios, communication systems, fare meters, flow meters for liquids transported by the vehicle, for example, milk, petroleum products etc. Vehicles where products may be permanently or temporarily installed include:

- *Road vehicles:* passenger cars, commercial vehicles, special vehicles, towing vehicles, trailers, mopeds, motor cycles, etc.
- *Rail vehicles:* trains, trams, cranes, etc.
- *Overland vehicles:* four wheel drive cars, tractors, snow scooters, etc.
- *Handling and storage vehicles:* fork-lift trucks (manual and robot), luggage transporters, etc.
- *Self-propelled machinery:* diggers, harvesters, etc.

Although this standard is not designed for products forming part of the vehicles, the environmental condition classification may also be used for some exchangeable parts, installed in a similar way and in the same locations of the vehicle as products which do not form part of the vehicle. Only severe conditions which may be harmful to products are included.

Conditions of storage and transportation are given in IEC Publications 721-3-1: Classification of Environmental Conditions, Part 3: Classification of Groups of Environmental Parameters and Their Severities — Storage (in preparation), and 721-3-2: Part 3: Classification of Groups of Environmental Parameters and Their Severities — Transportation.

2. Object

To classify the environmental parameters and their severities, to which a product will be exposed under its conditions of use when installed in ground vehicles.

A limited number of classes of environmental conditions are given, covering a broad field of application. The user of this standard should select the lowest class necessary covering each of the conditions of the intended use. Some guidance for this is given in Appendix A.

3. General

Reference to IEC Publication 721-3-0: Classification of Environmental Conditions, Part 3: Classification of Groups of Environmental Parameters and Their Severities — Introduction, is strongly recommended in order to avoid misuse of the classes defined in the other parts of IEC Publication 721-3.

The severities specified are those which will have a low probability of being exceeded. All specified values are maximum or limit values. These values may be reached, but do not occur permanently. Depending on the situation there may be different frequencies of occurrence related to a certain period of time. Such frequencies of occurrence have not yet been included in this standard, but should be considered for any environmental parameter. They should additionally be specified if applicable.

It is planned to include information on duration and frequency of occurrence in IEC Publication 721-3-0.

Attention is drawn to the fact that combinations of the environmental parameters given may increase the effect on a product. This applies especially to the presence of high relative humidity in addition to biological conditions or to conditions of chemically or mechanically active substances.

4. Definitions

In addition to the definitions in Clause 3 of IEC Publication 721-1: Classification of Environmental Conditions, Part 1: Classification of Environmental Parameters and Their Severities, the following definitions apply to this standard:

4.1 *internally mounted*

The product is mounted internally in the vehicle, in a compartment which affords some protection from the environment, ranging from complete isolation from external influences to protection only from precipitation when the vehicle is not moving.

4.2 *externally mounted*

The product is mounted on the outside of the vehicle. It is not protected from any external influences.

4.3 *weatherprotected location*

A location in which the vehicle is protected from direct weather influences. The locality is assumed to be reasonably ventilated (at least natural air flow).

5. Classification of groups of environmental parameters and their severities

A limited number of classes for climatic conditions (K), biological conditions (B), chemically active substances (C), mechanically active substances (S), contaminating fluids (F) and mechanical conditions (M) are given in Tables I, II, III, IV, V and VI. For a given product reference should be made to the total set of classes, for example, 5K2/5B1/5C3/5S2/5F1/5M2.

The basis of these classes is explained in Clause A3 of Appendix A.

The combination of the lowest classes 5K1/5B1/5C1/5S1/5F1/5M1 forms the condition to which a product will be subjected when being installed in, for example, smooth running vehicles used only in very restricted conditions (indoors).

The combination of the highest classes 5K4/5B3/5C3/5S3/5F3/5M3 covers installations in a wide number of types of vehicles including locations with very severe conditions. For a number of environmental parameters and classes special severities are given for products installed in engine compartments.

A class with higher digit conditions normally includes all classes with lower digits. For certain parameters it has not yet been possible to give quantitative severities.

A summary of the conditions covered by the classes is given in Clause A3 of Appendix A.

Note. — The classes contain values which do not appear in IEC Publication 721-1. It will be revised when all parts of IEC Publication 721-3 have been completed.

TABLE I

Classification of climatic conditions

Environmental parameter	Unit	Class					
		5K1	5K2	5K3	5K4	5K4H	5K4L
a) Low temperature, air	°C	+5	−25	−40	−65	−25	−65
b) High temperature, air in ventilated compartments (except engine compartments) or outdoor air[1]	°C	+40	+40	+40	+55	+55	+40
c) High temperature, air in unventilated compartments, except engine compartments[2]	°C	No	+70	+70	+85	+85	+70
d) High temperature, air in engine compartments	°C	+60	+70	+70	+85	+85	+70
e) Change of temperature, air/air[3]	°C	No	−25/+30	−40/+30	−65/+30	−25/+30	−65/+30
f) Gradual change of temperature, air/air, except in engine compartments	°C °C/min	No No	−25/+30 5	−40/+30 5	−65/+30 5	−25/+30 5	−65/+30 5
g) Gradual change of temperature, air/air, in engine compartments	°C °C/min	No No	−25/+60 10	−40/+70 10	−65/+70 10	−25/+70 10	−65/+70 10
h) Change of temperature, air/water, except in engine compartments[4][3]	°C	No	No	+40/+05	+55/+05	+55/+05	+40/+05
i) Change of temperature, air/water, in engine compartments[4][3]	°C	No	+60/+05	+70/+05	+85/+05	+85/+05	+70/+05
j) Change of temperature, air/snow, in engine compartments only	°C	No	+60/−05	+70/−05	+70/−05	+70/−05	+70/−05
k) Relative humidity, not combined with rapid temperature changes, except in engine compartments of vehicles powered by internal combustion engines	% °C	75 +30	95 +40	95 +45	95 +50	95 +50	95 +45
l) Relative humidity, not combined with rapid temperature changes, in engine compartments of vehicles powered by internal combustion engines	% °C	No No	No No	95 +70	95 +85	95 +85	95 +70
m) Relative humidity, combined with rapid temperature changes, air/air at high relative humidities. Not in close proximity to refrigerated air conditioning systems	% °C	No No	95 −25/+30	95 −40/+30	95 −65/+30	95 −25/+30	95 −65/+30
n) Relative humidity combined with rapid temperature changes, air/air, at high relative humidities. In close proximity to refrigerated air conditioning systems	% °C	No No	95 +10/+70	95 +10/+70	95 +10/+85	95 +10/+85	95 +10/+70
o) Absolute humidity combined with rapid temperature changes, air/air at high water content[5]	g/m³ of air °C	No No	60 +70/+15	60 +70/+15	80 +85/+15	80 +85/+15	60 +70/+15
p) Low relative humidity	% °C	10 +30	10 +30	10 +30	10 +30	10 +30	10 +30

Notes, see page 15.

TABLE I *(continued)*

Classification of climatic conditions

Environmental parameter	Unit	Class					
		5K1	5K2	5K3	5K4	5K4H	5K4L
q) Low air pressure	kPa	70	70	70	70	70	70
r) Movement of surrounding medium, air	m/s	No	20	20	30	30	30
s) Precipitation, rain	mm/min	No	No	6	15	15	6
t) Solar radiation	W/m²	No	700	1 120	1 120	1 120	1 120
u) Radiation, heat, not in engine compartments	W/m²	No	600	600	600	600	600
v) Radiation, heat, in engine compartments	W/m²	600	600	1 200	1 200	1 200	1 200
w) Water from sources other than rain[6]	m/s	No	0.3	1	3	3	3
x) Wetness	None	No	Conditions of wet surfaces				

[1] The high temperature of the surface of a product may be influenced by the surrounding air temperature given here and the solar radiation defined below.

[2] The high temperature of the surface of a product may be influenced by the surrounding air temperature given here and the solar radiation through a window or other opening.

[3] A direct transfer of the product between the two temperatures given is presumed.

[4] The lower temperature is equivalent to the temperature of tap water.

[5] The product is assumed to be subjected to a rapid decrease of temperature only (no rapid increase). The figures of water content apply to temperatures down to the dew-point; at lower temperatures the relative humidity is assumed to be approximately 100%.

[6] The figure indicates the velocity of water and not the height of water accumulation.

TABLE II

Classification of biological conditions

Environmental parameter	Unit	Class		
		5B1	5B2	5B3
a) Flora	None	No	Presence of mould, fungus, etc.	
b) Fauna	None	No	Presence of rodents or other animals harmful to products excluding termites	including termites

TABLE III

Classification of chemically active substances

Environmental parameter	Unit	Class		
		5C1	5C2	5C3
a) Sea salts	None	No	Conditions of salt mist	
b) Road salts	None	No	Conditions of solid salt and salt water	
c) Sulphur dioxide	mg/m^3	0.1	1.0 (0.3)	10 (5.0)
d) Hydrogen sulphide	mg/m^3	0.01	0.5 (0.1)	10 (3.0)
e) Nitrogen oxides (expressed in the equivalent values of nitrogen dioxides)	mg/m^3	0.1	1.0 (0.5)	10 (3.0)
f) Ozone	mg/m^3	0.01	0.1 (0.05)	0.3 (0.1)
g) Hydrogen chloride	mg/m^3	0.1	0.5 (0.1)	5.0 (1.0)
h) Hydrogen fluoride	mg/m^3	0.003	0.03 (0.01)	2.0 (0.1)
i) Ammonia	mg/m^3	0.3	3.0 (1.0)	35 (10)

Notes. — The figures given are maximum values, occurring over a 30 min period per day.

— The figures within brackets are mean values.

— Corresponding figures in cm^3/m^3 (at 20°C and 101.3 kPa) can be found in IEC Publication 721-1.

TABLE IV

Classification of mechanically active substances

Environmental parameter	Unit	Class		
		5S1	5S2	5S3
a) Sand (including grit)	g/m^3 of air	No	0.1	10
b) Dust sedimentation	mg/(m^2·h)	1.0	3.0	3.0

TABLE V

Classification of contaminating fluids

Environmental parameter	**Class**		
	5F1	**5F2**	**5F3**
a) Motor oil	**No**	**No**	**Yes**
b) Gearbox oil	**No**	**No**	**Yes**
c) Hydraulic oil	**No**	**Yes**	**Yes**
d) Transformer oil	**No**	**Yes**	**Yes**
e) Brake fluid	**No**	**Yes**	**Yes**
f) Cooling fluid	**No**	**Yes**	**Yes**
g) Grease	**No**	**Yes**	**Yes**
h) Fuel	**No**	**No**	**Yes**
i) Battery electrolyte	**No**	**Yes**	**Yes**

TABLE VI

Classification of mechanical conditions

Environmental parameter	Unit	Class		
		5M1	5M2	5M3
a) Stationary vibration, sinusoidal[1]				
displacement amplitude	mm	1.5	3.3	7.5
acceleration amplitude	m/s²	5	10 15	20 40
frequency range	Hz	2-9 9-200	2-9 9-200 200-500	2-8 8-200 200-500
b) Stationary vibration, random[1]				
acceleration spectral density	m²/s³	0.3 0.1	1 0.3	3 1
frequency range	Hz	10-200 200-500	10-200 200-500	10-200 200-500
c) Non-stationary vibration, including shock:				
shock response spectrum type I peak acceleration â	m/s²	50	100	300
shock response spectrum type II peak acceleration â	m/s²	No	300	1 000
d) Impact from foreign bodies, stones		No	The severities are under consideration pending classification if impacts from foreign bodies in IEC Publication 721-1	

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[1] The frequency range may be limited to 200 Hz also for classes 5M2 and 5M3 for products mounted on a structure with high internal damping.

[2] See Figure 1. For explanation, see IEC Publication 721-1, Sub-clause 5.3.

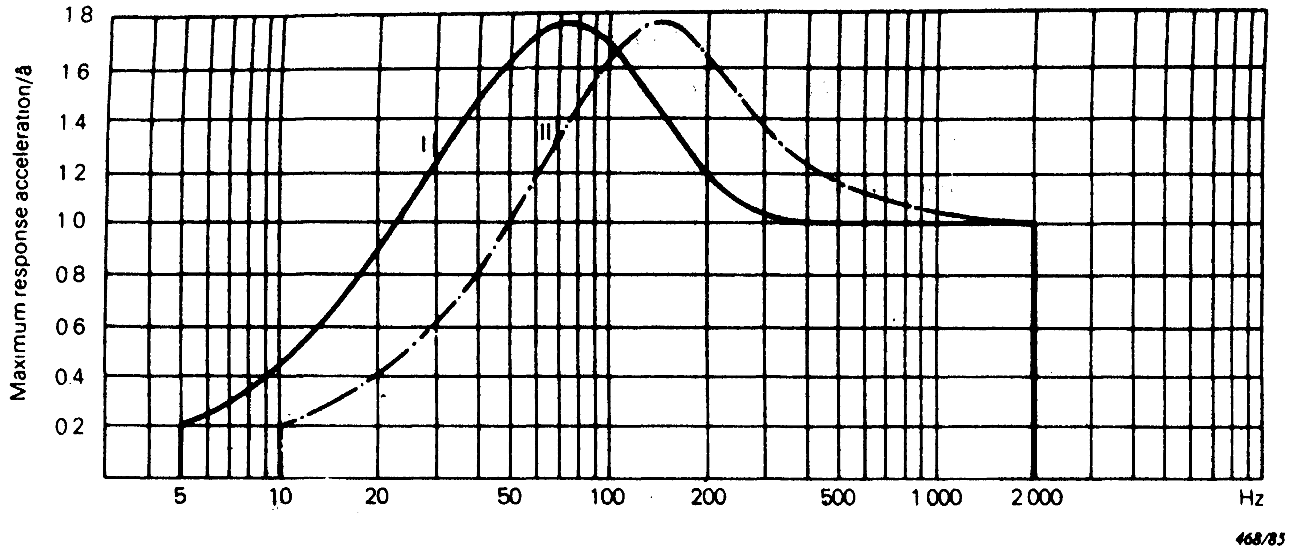

FIG. 1. — Model shock response spectra (first order maximal shock spectra).

APPENDIX A

SURVEY OF CONDITIONS AFFECTING THE CHOICE OF ENVIRONMENTAL PARAMETERS AND THEIR SEVERITIES

A1. **General**

In this appendix the basis of the classes is explained. It gives a survey of conditions affecting the choice of environmental parameters and their severities, and it contains a summary of the conditions covered by each class.

A2. **Survey of conditions**

For each environmental parameter the various possible conditions which will result in different levels of environmental conditions are presented. An effort has been made to arrange the conditions in order of increasing severities.

The first column of the tabulated Sub-clauses A2.1 to A2.6 on pages 25 to 45 describes the conditions. In the vertical columns headed Class, an × indicates the conditions covered by the class. The lowest class covering a certain condition may be found by reading horizontally from that condition to the first × encountered.

The procedure of finding an appropriate class as described above is valid for all the Sub-clauses, but the first part of Sub-clause A2.1 (pages 25 to 35) contains the additional factor of type of climate, given in columns 2 to 10 to which attention has to be paid.

The lowest class covering a certain condition can thus be found by reading vertically down the relevant type of climate column to the first × in the horizontal line of the relevant condition, then reading horizontally to the first × encountered as previously described.

The types of climate are described in IEC Publication 721-2-1: Classification of Environmental Conditions, Part 2: Environmental Conditions Appearing in Nature — Temperature and Humidity, and are:

Extremely Cold (except the Central Antarctic)
Cold
Cold Temperate
Warm Temperate
Warm Dry
Mild Warm Dry
Extremely Warm Dry
Warm Damp
Warm Damp, Equable

It should be noted that the fact that a certain condition referred to in this appendix is covered by a certain class does not necessarily mean that the class describes, for each single parameter, the lowest environmental severity needed to cover the condition.

Note. — Accidental incidents are not included. In certain cases the possibility of their occurrence may, however, need to be taken into account.

A2.1 *K. Climatic conditions*

Condition of installation	Type of climate									Class					
	Extremely Cold	Cold	Cold Temperate	Warm Temperate	Warm Dry	Mild Warm Dry	Extremely Warm Dry	Warm Damp	Warm Damp, Equable	5K1	5K2	5K3	5K4	5K4H	5K4L
a) Low temperature air °C										+5	−25	−40	−65	−25	−65
In vehicles used only in weatherprotected, heated locations, or in heated compartments: products used only after a warm-up period	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
External, or in unheated compartments, or in heated compartments: products used before a warm-up period	 ×	 ×	 × ×	× × ×	× × ×	× × ×	× × ×	× × ×	× × ×		×	× ×	× × ×	×	× × ×
b) High temperature, air, in ventilated compartments (except engine compartments) or outdoor air °C										+40	+40	+40	+55	+55	+40
In vehicles used only in weatherprotected, temperature controlled locations	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
In temperature controlled compartments	×	×	×	×	×	×	×	×	×		×	×	×	×	×
External, or in vehicles used only in weatherprotected, ventilated locations, or in ventilated compartments	× ×	× ×	× ×	× ×	× ×	× ×	 ×	× ×	× ×	×	×	×	× ×	× ×	×
c) High temperature, air, in unventilated compartments, except engine compartments °C										No	+70	+70	+85	+85	+70
In enclosed, unventilated compartments	× ×	× ×	× ×	× ×	× ×	× ×	 ×	× ×	× ×		×	×	× ×	× ×	×
d) High temperature, air in engine compartments °C										+60	+70	+70	+85	+85	+70
In vehicles powered by electrical engines, used only in weatherprotected, ventilated locations	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
In vehicles powered by electrical engines, used outdoors	× ×	× ×	× ×	× ×	× ×	× ×	 ×	× ×	× ×		×	×	× ×	× ×	×
In vehicles powered by internal combustion engines	× ×	× ×	× ×	× ×	× ×	× ×	 ×	× ×	× ×		×	×	× ×	× ×	×

A2.1 *K. Climatic conditions (continued)*

Condition of installation	Type of climate									Class					
	Extremely Cold	Cold	Cold Temperate	Warm Temperate	Warm Dry	Mild Warm Dry	Extremely Warm Dry	Warm Damp	Warm Damp, Equable	5K1	5K2	5K3	5K4	5K4H	5K4L
e) Change of temperature, air/air °C										No	−25/ +30	−40/ +30	−65/ +30	−25/ +30	−65/ +30
Not subjected to changes of surrounding air temperature	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
In compartments which may be directly subjected to outdoor air entering when windows, doors, lids, etc. are opened, or when outdoor air is drawn into the compartment, or externally: vehicle moved between warm indoor and cold outdoor conditions	×	× ×	× ×	× × ×	× × ×	× × ×	× × ×	× × ×	× × ×		×	× ×	× × ×	×	× × ×
f) Gradual change of temperature, air/air, except in engine compartments °C °C/min										No No	−25/ +30 5	−40/ +30 5	−65/ +30 5	−25/ +30 5	−65/ +30 5
In vehicles used only in weatherprotected locations	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
In compartments not directly subjected to outdoor air entering into the compartment. Vehicle not moved between outdoors and indoors, or moved between warm indoor and cold outdoor conditions	×	× ×	× ×	× × ×	× × ×	× × ×	× × ×	× × ×	× × ×		×	× ×	× × ×	×	× × ×
In compartments which are rapidly warmed up (by normal or additional heating system)	×	× ×	× × ×	× × ×	× × ×	× × ×	× × ×	× × ×	× × ×	×	×	× ×	× × ×	×	× × ×
g) Gradual change of temperature, air/air, in engine compartments °C °C/min										No	−25/ +60 10	−40/ +70 10	−65/ +70 10	−25/ +70 10	−65/ +70 10
In vehicles powered by electrical engines	×	× ×	× ×	× × ×	× × ×	× × ×	× × ×	× × ×	× × ×		×	× ×	× × ×	×	× × ×
In vehicles powered by internal combustion engines	×	×	×	× ×	× ×	× ×	× ×	× ×	× ×				× ×	×	× ×
h) Change of temperature, air/water, except in engine compartments[1] °C										No	No	+40/ +05	+55/ +05	+55/ +05	+40/ +05
Protected from rain. Not subjected to water from other sources	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
External. Subjected to rain or water jets directly after being subjected to solar radiation	× ×	× ×	× ×	× ×	× ×	× ×	×	× ×	× ×			×	× ×	× ×	×

---

[1] The lower temperature is equivalent to the temperature of tap water.

A2.1 *K. Climatic conditions (continued)*

Condition of installation	Type of climate									Class					
	Extremely Cold	Cold	Cold Temperate	Warm Temperate	Warm Dry	Mild Warm Dry	Extremely Warm Dry	Warm Damp	Warm Damp, Equable	5K1	5K2	5K3	5K4	5K4H	5K4L
i) Change of temperature, air/water in engine compartments[1] °C										No	+60/ +05	+70/ +05	+85/ +05	+85/ +05	+70/ +05
Not subjected to ingress of water	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
In vehicles powered by electrical engines. Subjected to ingress of water	×	×	×	×	×	×	×		×		×	×	×	×	×
	×	×	×	×	×	×	×	×	×			×	×	×	×
In vehicles powered by internal combustion engines. Subjected to ingress of water	×	×	×	×	×	×		×	×			×	×	×	×
	×	×	×	×	×	×	×	×	×				×	×	
j) Change of temperature, air/snow in engine compartments only °C										No	+60/ −05	+70/ −05	+70/ −05	+70/ −05	+70/ −05
Not subjected to ingress of snow	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
In vehicles powered by electrical engines. Subjected to ingress of snow	×	×	×	×	×	×					×	×	×	×	×
In vehicles powered by internal combustion engines. Subjected to ingress of snow	×	×	×	×	×	×						×	×	×	×
k) Relative humidity, not combined with rapid temperature changes, except in engine compartments of vehicles powered by internal combustion engines % °C										75 +30	95 +40	95 +45	95 +50	95 +50	95 +45
In vehicles used only in humidity controlled or heated localities	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
External or in ventilated compartments of vehicles used outdoors	×	×	×	×	×	×	×	×	×		×	×	×	×	×
In unventilated compartments with wet surfaces subjected to solar radiation (evaporation of water)	×	×	×	×	×	×		×	×			×	×	×	×
	×	×	×	×	×	×	×	×	×				×	×	
l) Relative humidity, not combined with rapid temperature changes, in engine compartments of vehicles powered by internal combustion engines % °C										No	No	95 +70	95 +85	95 +85	95 +70
With wet surfaces, risk of boiling water, etc. (The vehicles may not be moving)	×	×	×	×	×	×		×	×			×	×	×	×
	×	×	×	×	×	×	×	×	×				×	×	

---

[1] The lower temperature is equivalent to the temperature of tap water.

A2.1 *K. Climatic conditions (continued)*

Condition of installation	Type of climate									Class					
	Extremely Cold	Cold	Cold Temperate	Warm Temperate	Warm Dry	Mild Warm Dry	Extremely Warm Dry	Warm Damp	Warm Damp, Equable	5K1	5K2	5K3	5K4	5K4H	5K4L
m) Relative humidity, combined with rapid temperature changes, at high levels of relative humidity. % °C *Not in close proximity to refrigerated air conditioning systems*										No No	95 −25/ +30	95 −40/ +30	95 −65/ +30	95 −25/ +30	95 −65/ +30
Not subjected to significant temperature changes	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
External, or in compartments, partly open to outdoor air. Vehicles moved between indoors and outdoors	 ×	 × ×	 × ×	× × ×	× × ×	× × ×	× × ×	× × ×	× × ×		×	× ×	× × ×	× ×	× × ×
n) Relative humidity, combined with rapid temperature changes, air/air at high levels of relative humidities. % °C *Installed in close proximity to a refrigerated air conditioning system*										No	95 +10/ +70	95 +10/ +70	95 +10/ +85	95 +10/ +85	95 +10/ +70
In vehicles parked in direct solar radiation after a period of operation of the air conditioning system	× ×	× ×	× ×	× ×	× ×	× ×	 ×	× ×	× ×		×	×	× ×	× ×	×
o) Absolute humidity combined with rapid temperature changes air/air with high water content g/m^3 of air °C										No No	60 +70/ +15	60 +70/ +15	80 +85/ +15	80 +85/ +15	60 +70/ +15
In compartments subjected to rain or water jets after being subjected to solar radiation. Includes engine compartments of vehicles powered by electrical engines only	× ×	× ×	× ×	× ×	× ×	× ×	 ×	× ×	× ×		×	×	× ×	× ×	×
In engine compartments of vehicles powered by internal combustion engines. Temperature fall caused by rain falling onto the compartment in the situation where the air inside the compartment has a high water content, for example after boiling of the coolant or evaporation of water from wet surfaces	× ×	× ×	× ×	× ×	× ×	× ×	 ×	× ×	×		×	×	× ×	× ×	×

A2.1 *K. Climatic conditions (continued)*

Condition of installation	Class					
	5K1	5K2	5K3	5K4	5K4H	5K4L
p) Low relative humidity % °C	10 +30	10 +30	10 +30	10 +30	10 +30	10 +30
In vehicles used only in humidity controlled localities, or in heated compartments	×	×	×	×	×	×
q) Low air pressure[1] kPa	70	70	70	70	70	70
Altitudes where ground vehicles may operate	×	×	×	×	×	×
r) Movement of surrounding medium, air m/s	No	20	20	30	30	30
Protected from wind and speed-wind[2]	×	×	×	×	×	×
Protected from speed-wind.[2] Not protected from wind: world-wide climatic areas excluding hurricanes		×	×	×	×	×
Not protected from speed-wind.[2] Not protected from wind: world-wide climatic areas including hurricanes				×	×	×
s) Precipitation, rain mm/min	No	No	6	15	15	6
Protected from precipitation	×	×	×	×	×	×
Not protected from precipitation: climatic areas with normal rain intensities			×	×	×	×
Not protected from precipitation: world-wide climatic areas				×	×	
t) Radiation, solar W/m²	No	700	1 120	1 120	1 120	1 120
Protected from solar radiation	×	×	×	×	×	×
Exposed to solar radiation only through windows		×	×	×	×	×
Exposed to direct solar radiation			×	×	×	×
u) Radiation, heat, not in engine compartments W/m²	No	600	600	600	600	600
Not subjected to heat radiation	×	×	×	×	×	×
Subjected to heat radiation from heating elements		×	×	×	×	×
v) Radiation, heat, in engine compartments W/m²	600	600	1 200	1 200	1 200	1 200
In engine compartments of vehicles powered by electrical engines. Subjected to heat radiation from external parts of the engine	×	×	×	×	×	×
In engine compartments of vehicles powered by internal combustion engines. Subjected to heat radiation from external parts of the engine, exhaust pipes, etc.			×	×	×	×

---

[1] The value 70 kPa represents a limit value for ground transport, normally at about 3 000 m altitude. In some geographical areas ground transport may take place at higher altitudes.

[2] Speed-wind is the relative movement of air and vehicle, caused by the speed of the vehicle.

A2.1 *K. Climatic conditions (continued)*

Condition of installation	Class					
	5K1	5K2	5K3	5K4	5K4H	5K4L
w) Water from sources other than rain m/s	No	0.3	1	3	3	3
Protected from ingress of water	×	×	×	×	×	×
Subjected to dripping water from leaking pipes, condensation on inner parts above the product, etc.		×	×	×	×	×
Subjected to splashing water via ground			×	×	×	×
Subjected to sprays and jets, for example from washing, including motor washing. Mainly externally mounted products and products mounted in engine compartments				×	×	×
x) Wetness	No	Wet surface conditions				
In dry conditions	×	×	×	×	×	×
In wet areas, for example on wet surfaces		×	×	×	×	×

Note. — Although combined environments are not classified, it should be noted that formation of ice may occur on externally and internally mounted products. This can be caused by condensation and freezing on cold surfaces, undercooled rain water, or the combination of air velocity and relative humidity depending on the shape of the product.

A2.2 *B. Biological conditions*

Condition of installation	Class		
	5B1	5B2	5B3
a) Flora	No	Presence of mould, fungus, etc.	
Areas with negligible risks of growth of mould, fungus, etc., or protected from growth of mould, fungus, etc.	×	×	×
Areas with risks of growth of mould, fungus, etc. Not protected from growth of mould, fungus, etc.		×	×
b) Fauna	No	Presence of rodents or other animals harmful to products:	
		excluding termites	including termites
Areas with negligible risks of attacks by termites, rodents and other animals, which may damage the product. Protected from animals	×	×	×
Areas with risks of attacks by rodents and other animals excluding termites. Not protected from animals		×	×
Areas with risks of attacks by animals including termites			×

A2.3 C. *Chemically active substances*

Condition of installation	Class		
	5C1	5C2	5C3
a) Sea salts	No	Conditions of salt mist	
External, or in compartments of vehicles used only in weatherprotected locations, or in compartments not open during driving	×	×	×
External, or in compartments partly open during driving, for example in engine compartments		×	×
b) Road salts	No	Conditions of solid salt and salt water	
External, or in compartments of vehicles used only in weatherprotected locations, or in compartments protected from ingress of road salts and splashing water	×	×	×
External, or in compartments partly open during driving, for example, in engine compartments. Not protected from ingress of road salts or splashing water		×	×
c) Sulphur dioxide mg/m^3	0.1	0.5 (0.3)	10 (5.0)
d) Hydrogen sulphide mg/m^3	0.01	0.5 (0.1)	10 (3.0)
e) Nitrogen oxides mg/m^3	0.1	1.0 (0.5)	10 (3.0)
f) Ozone mg/m^3	0.01	0.1 (0.05)	0.3 (0.1)
g) Hydrogen chloride mg/m^3	0.1	0.5 (0.1)	5.0 (1.0)
h) Hydrogen fluoride mg/m^3	0.003	0.03 (0.01)	2.0 (0.1)
i) Ammonia mg/m^3	0.3	3.0 (1.0)	35 (10.0)
Note. — The figures given are maximum values, occurring over a 30 min period per day. The figures within brackets are mean values.			
In vehicles used in areas without industry or permanent motor traffic, or in compartments of vehicles used in areas with moderate industrial activities and traffic	×	×	×
External, or in partly open compartments of vehicles used in areas with normal industrial activities, not including industries emitting large quantities of chemical pollutants, or in compartments of vehicles used in areas with industrial sources emitting high quantities of chemical pollutants.		×	×
External, or in partly open compartments of vehicles used in areas with industrial sources emitting large quantities of chemical pollutants			×

A2.4 *S. Mechanically active substances*

Condition of installation	Class		
	5S1	5S2	5S3
a) Sand (including grit) g/m³ of air *b) Dust sedimentation* mg/(m²·h)	No 1.0	0.1 3.0	10 3.0
In compartments protected from sand and dust, or in compartments not protected from dust but mainly protected from sand, of vehicles used outdoors. Small amounts of very fine sand may, however, penetrate the compartments, for example, from sand storms, from driving on gravel roads	×	×	×
External, or in partly or fully open compartments of vehicles used outdoors or indoors. World-wide climatic areas, for vehicles used outdoors excluding sand desert areas		×	×
External, or in partly or fully open compartments of vehicles used outdoors. World-wide climatic area including sand deserts			×

A2.5 *F. Contaminating fluids*

Condition of installation	Class		
	5F1	5F2	5F3
a) Motor oil	No	No	Yes
b) Gearbox oil	No	No	Yes
c) Hydraulic oil	No	Yes	Yes
d) Transformer oil	No	Yes	Yes
e) Brake fluid	No	Yes	Yes
f) Cooling fluid	No	Yes	Yes
g) Grease	No	Yes	Yes
h) Fuel	No	No	Yes
i) Battery electrolyte	No	Yes	Yes
In compartments except engine compartments	×	×	×
In engine compartments of vehicles powered by electrical engines		×	×
In engine compartments of vehicles powered by internal combustion engines			×

A2.6 *M. Mechanical conditions*

Condition of installation	Class		
	5M1	5M2	5M3
a) Stationary vibration, sinusoidal			
displacement amplitude mm	1.5	3.3	7.5
acceleration amplitude m/s^2	5	10 15	20 40
frequency range Hz	2-9 9-200	2-9 9-200 200-500	2-8 8-200 200-500
b) Stationary vibration, random			
acceleration spectral density m^2/s^3	0.3 0.1	1 0.3	3 1
frequency range Hz	10-200 200-500	10-200 200-500	10-200 200-500
Vehicles powered by electrical engines, used only for driving indoors on smooth surfaces, e.g. robots in stores	×	×	×
Air-cushioned road vehicles, air-cushioned trailers, other road vehicles except tracked vehicles in areas with well-developed road systems. Excluding motorcycles, scooters and other vehicles with low mass. Trains with soft suspension, fork-lift trucks. Vehicles powered by internal combustion engines, passenger cars: on instrument panels, to which high frequency vibrations from engine or from parts connected to the engine may be transmitted		×	×
Road vehicles in areas without well-developed road systems, trailers, trains with hard suspension. Tracked vehicles and self-propelled machinery. Overland vehicles. Motorcycles, scooters and other vehicles with low mass. All vehicles except passenger cars: on instrument panels to which high frequency vibrations from engine or from parts connected to the engine may be transmitted *Note.* — Products mounted with direct connection to the power unit or parts not isolated from the ground by suspension, e.g. on rolling stock bogies, can have vibrations in excess of those given here. These cases are under consideration.			×

A2.6 *M. Mechanical conditions (continued)*

Condition of installation	Class		
	5M1	5M2	5M3
c) Non-stationary vibration, including shock:			
shock response spectrum type I			
peak acceleration $\hat{a}$ m/s^2	50	100	300
shock response spectrum type II			
peak acceleration $\hat{a}$ m/s^2	No	300	1 000
Vehicles powered by electrical engines, used only for driving indoors on smooth surfaces, for example, robots in stores	×	×	×
Road vehicles in areas with well developed road systems. Air cushioned trailers. Locomotives, wagons with specially designed buffers to reduce shock. Fork-lift trucks. Excluding motorcycles, scooters and other vehicles with low mass		×	×
Road vehicles in areas without well developed road systems. Trailers. Wagons, including shunting. Motorcycles, scooters and other vehicles with low mass			×
d) Impact from foreign bodies, stones	No	Under consideration	
Vehicles used indoors. Vehicles used outdoors: in compartments on surfaces which are not subjected to flying stones	×	×	×
In compartments on surfaces, which may be subjected to flying stones		×	×
External, in places which may be directly hit by flying stones			×

A3. Summary of conditions covered by the classes

A3.1 *K. Climatic conditions*

These are covered by six class notations as follows:

5K1 5K1 covers products installed in vehicles used in weatherprotected, ventilated, heated locations or in heated, ventilated vehicle compartments, used only after a warm-up period.

The products are not assumed to be subjected to changes, momentary or gradual, of the surrounding air temperature. They are protected from ingress of water and snow. Installation in close proximity to a refrigerated air conditioning system is not covered. The products themselves and the compartments in which they are installed are not subjected to solar radiation.

The products may be installed in the engine compartments of vehicles powered by electrical engines and subjected to heat radiation from external parts of the engine.

5K2 In addition to the conditions covered by 5K1, 5K2 covers products installed in enclosed or partly open, heated or unheated, unventilated compartments. The products may be subjected to heat from heating elements and solar radiation through windows or other openings. Includes vehicles used outdoors.

The outdoor use of vehicles is limited to climatic areas with normal rain intensities, excluding Extremely Cold, Cold, Cold Temperate and Extremely Warm Dry Climates.

Note. — For some environmental parameters (low air temperature, high air temperature) 5K2 also covers externally mounted products.

The products may be directly subjected to outdoor cold air entering the compartments when the vehicle is moving. The vehicle may be moved between cold outdoor and warm indoor conditions.

The products may also be subjected to dripping water and conditions of wet mounting surfaces.

The class also covers products installed in engine compartments of vehicles powered by electrical engines, used outdoors. They may be subjected to ingress of water and snow.

5K3 In addition to the conditions covered by 5K2, 5K3 covers vehicles used in the Cold Temperate Open-air Climate. It also covers installations in unventilated compartments and installations in compartments with wet surfaces, subjected to solar radiation.

The products may be subjected to direct solar radiation and rain.

The environmental conditions for products mounted in engine compartments of vehicles powered by electrical engines are also covered.

5K4 In addition to the conditions covered by 5K3, 5K4 covers vehicles used in World-wide Open-air Climates. The products may also be directly subjected to sprays and jets (e.g. from washing).

5K4H Class 5K4H is similar to 5K4, but the low temperature condition is the same as that of class 5K2.

5K4L Class 5K4L is similar to 5K4, but the high temperature conditions are the same as those of class 5K2.

A3.2 *B. Biological conditions*

These are covered by three class notations as follows:

5B1 5B1 covers installations in areas without particular risks of biological attacks, from flora or fauna. It includes installations in compartments of such construction that mould growth, attacks by animals, etc. are not probable.

5B2 In addition to the conditions covered by 5B1, 5B2 includes areas and conditions where mould growth, attacks by animals, except termites, may occur.

5B3 In addition to the conditions covered by 5B2, 5B3 includes areas where attacks by termites may occur.

A3.3 *C. Chemically active substances*

These are covered by three class notations as follows:

5C1 5C1 covers installations in vehicles only used indoors and in compartments not open to the outdoor atmosphere during driving, protected from ingress of road salts and splashing water.

5C2 In addition to the conditions covered by 5C1, 5C2 covers externally mounted products and products internally mounted in partly open compartments. The products may be subjected to ingress of road salts or splashing water. Externally mounted products in vehicles used in areas with industrial sources emitting large quantities of chemical pollutants are not covered.

5C3 In addition to 5C2, 5C3 covers externally mounted products in vehicles used in areas with industrial sources emitting high quantities of chemical pollutants.

A3.4 *S. Mechanically active substances*

These are covered by three class notations as follows:

5S1 5S1 covers installations of internally mounted products not protected from dust but mainly protected from sand.

5S2 In addition to the conditions covered by 5S1, 5S2 includes internally and externally mounted products, not protected from sand and dust on vehicles not used in desert areas.

5S3 In addition to the conditions covered by 5S2, 5S3 includes vehicles used in desert areas.

A3.5 *F. Contaminating fluids*

These are covered by three class notations as follows:

5F1 5F1 covers installations outside engine compartments.

5F2 In addition to the conditions covered by 5F1, 5F2 includes engine compartments of vehicles powered by electrical engines.

5F3 In addition to the conditions covered by 5F2, 5F3 also includes engine compartments of vehicles powered by internal combustion engines.

A3.6 *M. Mechanical conditions*

These are covered by three class notations as follows:

5M1 5M1 covers installations in vehicles powered by electrical engines, used only for driving indoors on smooth surfaces (e.g. robots in stores).

5M2 In addition to the conditions covered by 5M1, 5M2 includes all kinds of road vehicles, except tracked vehicles and motorcycles, scooters and other vehicles with low mass, used in areas with well developed road systems. It includes installations in compartments on surfaces which may be subjected to flying stones.

5M3 In addition to the conditions covered by 5M2, 5M3 covers road vehicles in areas without well developed road systems, lightweight vehicles, tracked vehicles and self propelled machines. It includes installations in places which may be directly hit by flying stones.

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Amendment 1

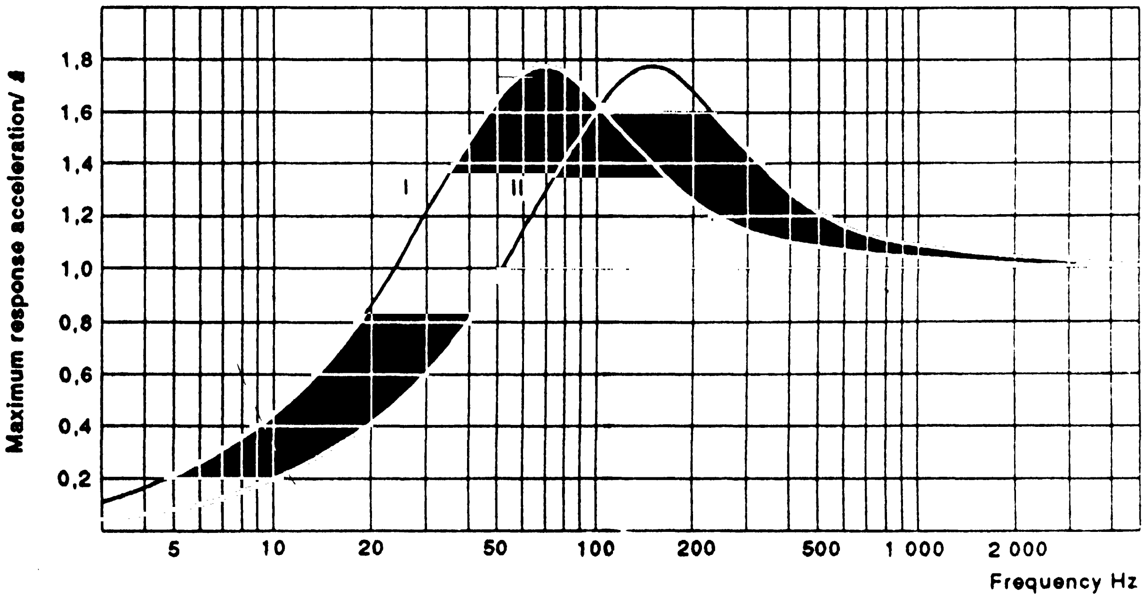
Page 7

TABLE VI: *Classification of mechanical conditions*

In column 5M3, item d), second line, change if *to* of.

Page 8

Replace figure 1 by the following:



***Example of durations for half-sine pulse*:**

Spectrum type I: duration 11 ms
Spectrum type II: duration 6 ms

Figure 1 - Model shock response spectra (first order maximax shock response spectra). For explanation see note 6 relating to table I of IEC 721-1 (1990)

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